Oxy-Acetylene Welding
(OAW)

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1. Welding Terms

a. Fusing; Heating two or more metals or nonmetals until they become _____, then allowing them to ____ and solidify.

b. Fusion Welding; Welding that uses fusion or _____ metals to make a weld.

c. Oxy-acetylene Welding; A welding process that burns _____ and _____in a flame to create a heat source for fusion.

d. Weld pool or puddle; Molten area during a _____process.

e. Backfire; Popping noise when the flame suddenly burns back into the tip but _____ _____. (explosion at the tip)

d. Flashback; When the flame burns back _____ the tip, torch, hose, or regulators. (pop - followed by a shrill squealing or hissing sound)

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2. Oxy-Acetylene Welding Process

a. Flame creates heat source to _____base metals.

b. Creates _____ gas which shields liquefied metal from atmospheric contaminates. (_____**,** _____)

c. Filler rod can be added to help join base metals and _____ weld joint strength.

d. Manual welding process. Requires skill to form, maintain, and move a uniform _____ _____ of molten metal along the weld.

e. Used primarily for welding _____ gage steel. _____ work.

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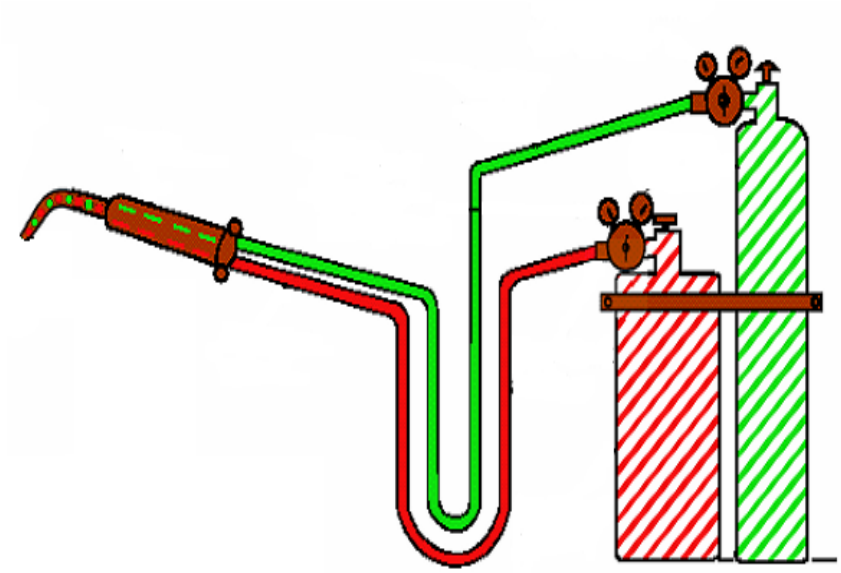
3. Oxy-Acetylene Welding Equipment

- Oxygen Cylinder
- Acetylene Cylinder
- Oxygen Regulator& Gages
- Acetylene Regulator& Gages
- Oxygen Hose
- Acetylene Hose
- Flash Back Arresters
- Torch Handle (body)
- Torch Tip



4. Personal Protection

a. Safety glasses; ANSI Z87.1
b. Clothing; Fire resistant materials, Leather, _____ – no synthetics like polyester. No turned up or frayed cuffs. Long sleeves and collars buttoned.
c. Boots; Leather, steel toes, slip on best, no exposed _____.
d. Gloves; Gauntlet, flexible but _____ enough for heat protection.
e. Goggles, Shield; #3 – **5** shaded lens. (ultraviolet/ infrared light)
f. Ear protection; muffs, plugs, (out of position welding/ cutting)

g. Never have a pressurized butane_____ on your person while in the shop.

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5. Oxygen Gas

a. (O^2); colorless, odorless, tasteless, _____, non-flammable, gas.
b. Welding grade about _____ pure.
c. Most common method- obtained from _____. (21% O^2)
d. Purified & cooled under high pressure until _____.
e. Separated from **Nitrogen** (-320º F), O^2 (-296º F) by _____.
f. Supports combustion when mixed with other _____.
g. Never use to blow off _____ or mix _____ with oxygen.

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6. Acetylene Gas

a. (C_2H_2); Equal parts_____ & Hydrogen.
b. Colorless gas, pungent odor due to _____.
c. Made by mixing Calcium Carbide &_____.
d. Dissociates (separates) under _____& releases heat.
e. Highly unstable over 15 psi. – can cause _____.
f. Highly explosive when mixed w/ _____.
g. Forms explosive compounds when mixed with _____ or _____.

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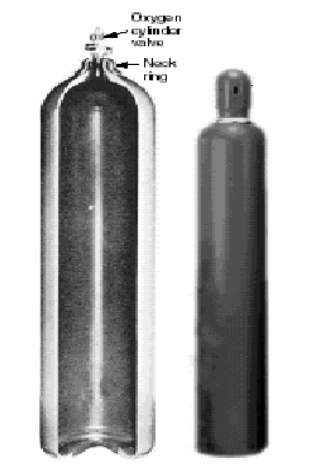
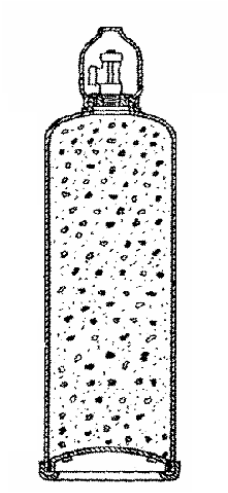
7. Oxygen Cylinders



a. Seamless drawn steel tube, minimum ___" thick, tested to 3360 psi.
b. Cylinder sized by _____ capacity.
c. _____cu.ft. large size, 122cu.ft. medium, 80cu.ft. small.
d. Filled to 2200 psi @ _____**º** F. (pressure changes w/ temperature)
e. Fitted w/ high pressure, _____ seat valve – open completely.
f. Right-hand male outlet fitting, w/ _____ _____ _____.
g. Protective cap screws to _____ _____. (ring is pressed fit - not welded)
h. Bottles can _____ if dropped, struck, punctured, arced across.

8. Acetylene Cylinders



a. Welded cylinders w/safety fuse plugs - release contents at _____ ºF.
b. Filled w/ porous _____ material. (Calcium Silicate 8-10%).
c. Calcium Silicate saturated w/ _____. (42% of internal volume)
d. Acetylene dissolves in Acetone and is safely held above _____ psi. (36% of internal volume)
e. Acetone is _____, never lay Acetylene cylinders down or draw off more than _____ the volume of the cylinder. Keep cylinder upright for_____ hrs. before use.
f. Possible to draw acetylene _____ than acetone can release it. Cylinder gage may read zero. Pressure will return if left alone.
g. Cylinder sized by cu.ft. capacity. ____cu.ft. common size @____ psi.
h. Fitted with valve (some have _____ wrench) and safety cap.
i. No relief valve; _____% reserve in tank.
j. Open valve _____ to _____ turn or until _____ _____ _____.
k. Left-hand_____ outlet fitting.

9. Cylinder Handling

a. Handle, store, transport in _____ position.
b. Use cylinder hand-truck w/ _____ to transport.
c. Replace cylinder caps, don't lift bottles by_____.
d. Open & close valves by hand – no_____.
e. Never roll cylinders _____.
f. Store Oxygen & Acetylene cylinders separately, _____ft. minimum or 5' wall w**/**_____ burn.
g. Secure cylinders with _____ or _____ at all times.

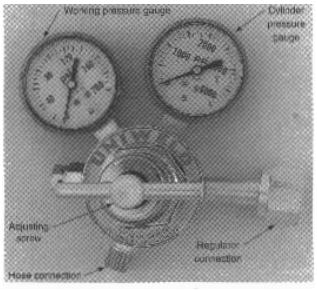
10. Regulator Function

a. Control the amount of gas flow from the _____.
b. Maintain the required _____ pressure**.**
c. Produce _____ flow of gas under _____ cylinder pressures.

11. Single- Stage Regulators

a. Cheapest; gas flows directly to _____ _____ chamber and is controlled by diaphragm and adjusting screw. (right-hand threads)
b. Must be continuously adjusted as cylinder pressure _____.
c. Adjusting screw must be _____ before opening cylinder - extreme pressure can blow out screw or damage regulator.
d. Unscrewing pressure adjustment screw _____gas flow.
e. Use w/ _____ _____.

12. Two - Stage Regulators



(Picture of Oxygen Regulator)

a. Gas flows from cylinder into high pressure _____.
b. High pressure controlled by _____ & _____.
c. Gas flows into _____ chamber, controlled by adjusting screw which pushes on larger stainless steel diaphragm.
d. Unscrewing pressure adjustment screw _____ gas flow.
e. Use w/ _____system.

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13. Oxygen Regulator Gages & Fittings

a. Cylinder pressure gage; graduated up to _____ psi.
b. Working pressure gage; graduated from _____ psi.
c. Female inlet fitting to cylinder is _____ thread.
d. Never use_____ on fittings.

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14. Acetylene Regulator Gages & Fittings

a. Cylinder pressure gage; graduated up to _____ psi.
b. Working pressure gage; graduated from _____psi. w/ red warning color above _____ psi.
c. Male inlet fitting to cylinder is _____with a left-hand thread.
d. Never use _____ on fittings.

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15. Flashback Arrestors & Check Valves

Flashback Arrester

a. Installed between hoses and torch (_____ mounted) or hoses and regulators (regulator mounted). Install in proper _____.
b. Flash Arrester - Has built in _____ _____ that prevents reverse gas flow and a _____ barrier that prevents a flame from moving from the torch back through the hose and regulators.
c. Check valves - prevents reverse gas flow _____. May not stop Flashback
d. Check valves close when the pressure on the torch side _____ the pressure from the regulator. (Flashback)
e. Check valves may need to be_____ if a flashback has occurred.
f. Never use _____ on connections.

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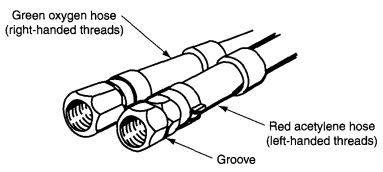
16. Oxygen & Acetylene Hoses



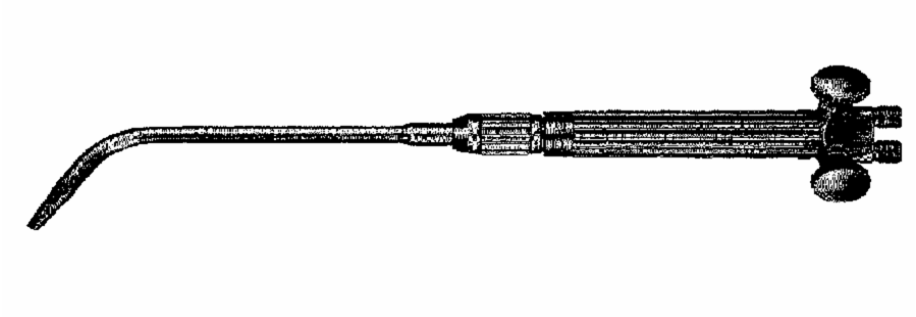
a. Oxygen hose is commonly **green** in the United States.
b. Acetylene hose is commonly **red**.
c. Rubber / Nylon. Different types for the **type** of fuel gas.
d. Oxygen fittings are **right-hand** thread, Acetylene fittings are **left-hand** thread with a notch in the middle of the fitting.
e. New hose is dusted w/ **talcum powder** and should be blown out w/ dry, clean, compressed air. Never use oil on connections.
f. Use proper care for hoses. Flame resistant, can be **burned** through and **cut**.

17. Torch Function

a. Control and mix the oxygen and fuel gas within the _____ _____ of the torch**.**
b. Direct the_____ to the work area.

18. Torch Parts

- Welding Tip
- Mixing Chamber
- Torch Body (Barrel)
- Valves
- Oxygen & Fuel gas Connections

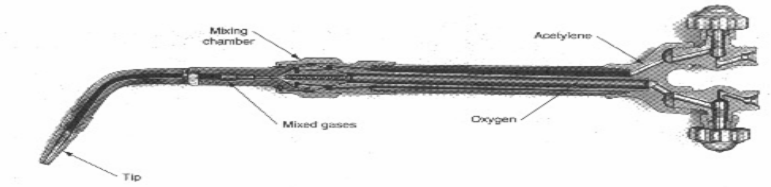


19. Torch Types

a. Positive Pressure; (also called an _____ _____ or medium pressure torch)
b. Injector; (also called a _____ _____torch)

20. Positive Pressure Torches

a. Most common type.
b. Feeds oxygen and fuel into mixing chamber at relatively _____ pressures.
c. Mixing chambers may be in _____ _____ or tip.
d. Fuel gas pressures must be above _____psi. to function.



21. Injector Torches

a. Forces high pressure Oxygen through _____, which draws low pressure fuel gas into the mixing chamber.
b. Fuel gas pressure can be as low as _____psi. (Acetylene Generator)
c. Draws more _____out of cylinders.

22. Torch Valves & Connectors

a. Valves may be located on either_____ of the torch body.
b. _____valves; use finger force only – never a wrench.
c. Over-tightening valves will damage _____ _____ and cause it to leak.
d. Oxygen connector is _____-hand thread.
e. Acetylene connector is _____**-**hand thread.
f. Oxy or Fuel - usually marked on _____at torch body.
g. Never use _____on valves or connections.

23. Types of Tips

a. Welding.
b. Cutting.
c. Heating (_____ _____).

24. Welding Tip Styles

a. One-piece tube-and-tip _____.
b. Two-piece tip; small torch tip threaded into _____tube.
c. Both are attached to the torch body and mixing chamber.
d. In-tip mixers; torch tips with their own _____ chamber.

25. Tip Sizes

a. Measured by the diameter of the _____ at the end of the tip.
b. Tip size affects the amount of _____ – not temperature of the flame.
c. Must select correct _____size for the job. (thickness of metal)
d. No standard tip size measurement_____.
e. Use_____ system; 000 (smallest) to 15 (largest).
f. Use _____ _____ number; 1 - 80, larger # = smaller orifice size.

26. Tip Selection

a. _____ of metal.
b. Working pressures must match _____ _____. Follow manufactures recommendation.

27. Tip Care

a. Keep tip _____. (slag, carbon, molten metal distorts flame and can cause backfire or flashback)
b. Use correct size tip _____. (don't enlarge or elongate orifice)
c. Do not remove _____ tips from tip tube or install _____ tip on hot tip tube.
d. Do not_____ the torch or the tip.
e. _____ _____ torch when not in use.

28. Equipment Set-up Procedure

a. Securely _____or fasten cylinders in vertical position.
b. Remove safety caps.
c. Quickly crack open cylinder _____ to clear dirt. (stand to side)
d. Connect _____ by hand and tighten with a proper fitting wrench. (Attach Flashback arrester to regulator)
e. Attach _____ to respective regulators. (purge regulator & hose)
f. Attach check valve or _____arrester to torch.
g. Attach torch body & check valve/arrester to hoses by hand and _____ with proper fitting wrench.
h. Select and install correct _____ _____. Align w/ valves.
i. _____-tighten only; tightening with a wrench will damage seal and allow connection to leak.
j. Pressurize system following proper procedures and check all connections and fittings for leaks using _____ water or commercial leak test solution. (check valve stem at the cylinder)
k. Never test for leaks with_____ or heat source.

29. Pressurizing System & Lighting Torch

a. Check that torch valves are _____ and pressure adjustment screws on the regulators are backed _____.
b. _____ crack open cylinder valves. Open Oxygen _____ - Acetylene _____ turn. Always stand to the side of the gages – never in front of them.
c. Set working pressures separately. Open torch valve. Adjust pressure adjustment screw at regulator to desired pressure. _____ torch valve. Always purge gas lines – 3 to 4 seconds per 25' of hose before lighting torch.
d. To light torch, open acetylene valve first, _____ turn. Light torch facing _____with sparklighter held approximately 1" from torch tip.
e. Adjust acetylene flame until _____almost disappears.
f. Open torch _____ _____ and adjust to desired flame type.

30. Welding Flame

a. Reducing or Carburizing; _____ acetylene.
b. Neutral; _____ amounts of gases.
c. Oxidizing; excess _____.
d. Flame affected by too little or too much _____ _____.
e. Inner cone releases over ____ of heat.
f. Too small or large flame; can cause tip to _____ _____, backfire, poor weld quality.

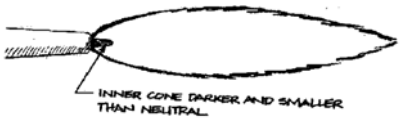
31. Reducing or Carburizing Flame

a. Excess acetylene, cooler, soft flame - ºF
b. Three flames; inner cone, intermediate or secondary cone, (_____ _____) outer flame.
c. Used for soldering & _____ applications.
d. Introduces excess _____into weld puddle – causes hard, brittle weld. Not used for fusion welding on mild steel.

32. Neutral Flame

a. _____ parts of oxygen & acetylene.
b. Two flames; well defined _____ _____ & near colorless outer flame.
c. Soft sound, burns @ approximately _____º F.
d. Chemically neutral. Protects puddle w/ _____ by product.
e. Used for_____ welding operations.

33. Oxidizing Flame

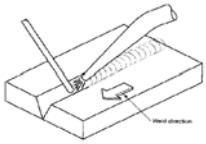


a. _____oxygen.
b. Two flames; smaller, sharp - pointed inner cone & bright _____, smaller, flared - outer flame.
c. Harsh, hissing sound; burns @ approximately _____º F.
d. Used for some _____ operations.
e. Excess oxygen forms oxides in weld puddle causing brittleness, weakness.
f. Tendency to leave _____ in weld pool (harsh flame) and burn steel.

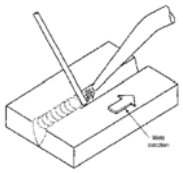
34. Holding the Torch

a. Over-Hand or_____ grip; balance the torch in hand w/ light grip.
b. Place hoses over shoulder to reduce weight. Do not wrap around _____.
c. Support _____; get comfortable.

35. Torch Manipulation



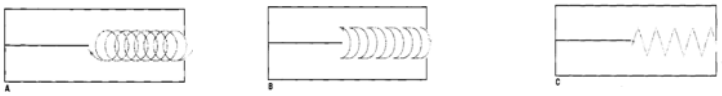
a. Forehand; welding flame pointed in _____of travel in downward angle. Filler metal dipped in front edge of puddle ahead of the flame. Flame pushes puddle. Used on thinner metals.



b. Backhand; welding flame pointed _____the direction of travel in a downward angle. Filler material dipped between flame and puddle. Flame pulls puddle. Used on thicker material and cover pass.

36. Torch Movement Patterns

a. Circular; approx. 1/4" dia. w/ _____" advance per circle.
b. Semicircular; approx. 1/4" wide w/ ___" advance per semicircle.
c. Weave; approx. 1/4" wide w/ ____" advance per side movement.



37. Work Angle

a. Angle of torch tip; measured _____ to travel direction.
b. Changes w/ type and_____ of joint. (90 to surface for flat position bead)
c. Use to control puddle &_____ distribution.

38. Travel Angle

a. Angle of torch tip, measured _____ to direction of travel.
b. Changes w/_____ and position of joint. (0-45 to surface for flat position bead)
c. Use to control _____ & heat distribution.

39. Travel Speed

a. Speed at which torch moves in_____ direction.
b. Constant speed produces even width, _____ bead w/ consistent penetration.
c. Give heat and puddle time to stay _____ of flame.

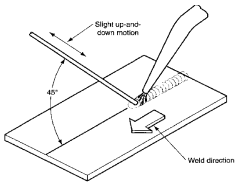
40. Torch Height

a. Distance from the tip of the neutral flame _____ to the puddle surface.
b. Keep approximately _____" from molten pool. (changes w/ tip size)
c. Do not allow cone to_____ into puddle. (Backfire, dirty tip, weld impurities, depressions in weld bead.

41. Filler Metal

a. Match filler metal properties to_____ metal properties.
b. Cut length rods, ___" standard length, 5-10 lb. tubes/ 50 lb. cartons.
c. Diameters; 1/16" – 3/16" in _____" graduations, 1/4", 5/16", 3/8".
d. Classified by American Welding Society (_____).
e. RG 45, RG60, RG65.
R =_____.
G = _____Welding.
45 = Minimum _____Strength (lbs.) X 10,000.
(ex. RG45 = 45,000 lbs.)
f. Use manufactures recommendations for tip size, _____ diameter, working pressures, per metal thickness.

42. Manipulating Filler Metal



a. Use correct _____; too large cools puddle – too small will not fill puddle.
b. Slant filler metal away from tip but at approximately the_____ angle as the tip.
c. Create and maintain full size puddle in base metal_____ dipping filler rod. (Stay off edges of material – they will over-heat)
d. Keep filler _____ to puddle when not dipping, keep it _____ but not molten. Use straight up and down dipping motion.
e. Forehand technique – Flat, Vertical, Over-head positions; dip slightly towards the_____ edge of the puddle.
Forehand technique – Horizontal position; dip towards _____ _____ edge of puddle
f. Allow puddle to melt _____ – not flame.
h. Melt rod away from base metal if rod becomes stuck – don't _____.
i. Obtain smooth and _____ rhythm.
j. Bend over_____ end of rod for safety.
k. Weld small lengths of _____ _____ together.
l. Use to set _____ opening.

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43. Backfire

a. Popping noise when the flame suddenly burns back into the tip but _____ _____. (explosion at the tip)
b. Can be caused by operating torch at too_____ pressure for tip.
c. Touching the welding _____ to the work or puddle.
d. _____ the tip.
e. _____ in the tip.
f. After Backfire: Shut off_____ valves – GAS IS STILL FLOWING, remedy the cause, relight torch

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43. Flashback

a. When the flame burns back inside the tip, torch, hose, or regulators and _____ _____ go out. (pop - followed by a shrill squealing or hissing sound)
b. Generally indicates something is wrong with equipment or _____.
c. Touching tip to the work or puddle - _____ in the tip.
d. _____the tip.
e. Wrong gas_____ pressure.
f. After Flashback: Shut off valves _____– GAS IS BURNING INSIDE THE TORCH AND WILL DAMAGE THE TORCH. Remedy the cause, inspect system, relight torch.
g. Flash Arresters will _____ flame at the torch if installed between the torch and the hoses.

44. Shutting Off Torch

a. Turn off torch _____ valve first – Acetylene second.
b. Close tank or manifold _____.
c. Open torch _____ valve, bleed all gas from hose and regulator.
d. Back out Acetylene pressure _____ _____at regulator. **Close torch Acetylene valve**.
e. Open torch _____ valve, bleed all gas from hose and regulator.
f. Back out Oxygen pressure _____ _____ at regulator. **Close torch Oxygen valve.**
g. Place torch on _____. Clean up work area. Cool metal _____ placing it in scrap bin.